MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

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Rev. CHARLES PRITCHARD, President, in the Chair.

Alexander Stewart Herschel, Esq., Professor of Astronomy, &c., at the Andersonian University, Glasgow; and
M. McNeal Walker, Esq., 3 Clyde Place, Glasgow,

were balloted for and duly elected Fellows of the Society.

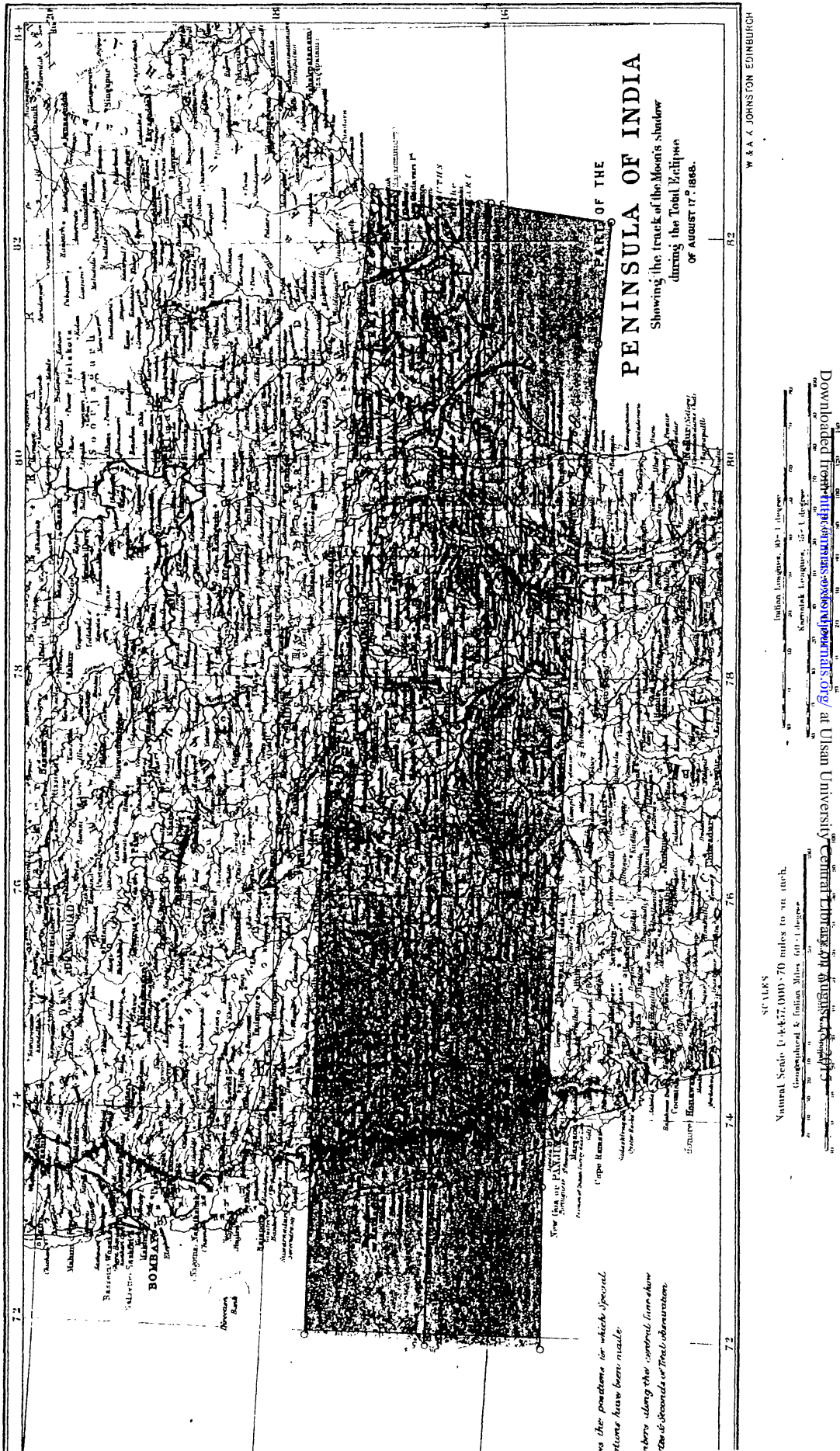*On the Eclipse of August* 1868.   By Major F. Tennant.

I a short time ago addressed you, calling the attention of the Council to the Total Solar Eclipse which will be visible in India next year.   I have now the pleasure of sending the results of the computations which I have made (as I proposed) on this subject, and beg to add a few remarks.

Total eclipses of the Sun are so rare, that when favourable for observations it has become the custom to seek the places where they are to be seen, and the one which is the subject of this letter is exceptionally favourable for those observations which can only be made during the total phase.   In this case at the time of conjunction of the Sun and Moon the latter is but 6 hours removed from her perigee, while the former is not very far from apogee; to the large difference of diameters hence arising must be added the augmentation of that of

the Moon due to the altitude which (as the nearest approach of the centres of the Sun and Moon is geocentrically only $2' 45''$) is very high. The result in this case is a totality which in India lasts between 5 minutes and 5 minutes 50 seconds.

In this case the central line enters on the west coast of India in latitude $16° 35'$, about 3 miles north of Viziadroog, and crosses the Peninsula, passing near Muktul and Guntoor, and as little north of Masulipatam. The shadow is about 143 miles broad. The northern limit passes close to the town of Sholapoor (which is accessible by rail from Bombay), about 12 miles north of the large city of Hydrabad in the Dukhun, and 18 miles north of Rajamundri, at the head of the Delta of the Godaveri. The southern limit lies 8 miles north of Goa, or 20 south of the station of Belgaum, 20 miles north of Bellary, 24 south of Kurnool, and 17 south of Ongole. It includes thus the stations of Kolapoor, Belgaum, Kurnool, Sikunderabad, Ongole, Guntoor, Masulipatam, and Rajahmundri, besides some smaller ones ; the whole course of the Kistna, its Delta and that of the Godaveri, and parts of the valleys of the Bhema and Toongabudra, lie within these limits. Leaving India proper the shadow crosses the Bay of Bengal, includes the North Andaman Island, and then passes through the Mergui Archipelago and the Province of Tenasserim across the Malay Peninsula to the Island of Borneo (including on its way part of the promontory S.W. from Saigon), which it reaches between our colony of Labuan and the Sarawak country, and eventually through Torres Straits. Of this course the west coast of India will be experiencing the S.W. Monsoon. The same state of things exists at the Andaman Islands and on the British side of the Malay Peninsula. The other side is not easily attainable, and I am not aware that there would be any inducement to go to Borneo. The eastern part of the track through India affords, I believe, every chance of fine weather, and I think observers would do well to select that part. I have computed for the whole breadth of the Indian peninsula, the central line, and the limits of totality, and I have transferred these lines to the accompanying map. I have computed also to a first approximation the track of the shadow till it leaves the Malay Peninsula,* and that portion of it from the Andamans to the East has been also laid down on the map. I have computed the times, &c., of the contacts and formulæ for obtaining the times in the neighbourhood of three places in the neighbourhood of the central line. The latitudes and longitudes used have been given, as I find they differ in different authorities accessible to me, but the variations are not very material ; and I hope that from these formulæ the times at any place within the limits of totality can be computed with suffi-

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* Omitted in Map as printed.

PENINSULA OF INDIA

PART OF THE

Showing the track of the Moon's shadow
during the Total Eclipse
OF AUGUST 17, 1868.

W & A K JOHNSTON EDINBURGH

SCALES

Natural Scale 1:4,437,000 = 70 miles to an inch.

Geographical & Indian Miles 60.1 degree

Indian Leagues, 40 = 1 degree

Kos with Indian Miles 15 = 1 degree

cient accuracy for enabling an observer to be prepared.   I have not extended the formulæ to other parts of the line, as I do not, for the reasons I have given, think they will be useful to English observers.

The total eclipse of 1860 settled that the red protuberances which were first prominently noticed in 1842 were attached to the Sun, but we have little further information.   It follows as a consequence of this, that they are of enormous size, but we know nothing of their constitution.   They appear not to be identical with faculæ, and I believe are not found to be connected with the spots.   If, however, we can see them, we now know that their light will furnish some information. We may hope to decide whether they are gaseous or composed of solid particles, whether they shine by their own light or by that of the Sun, and even to gather some information possibly as to their chemical constitution.   I think it desirable that this opportunity of making a contribution to our knowledge of the Sun should not be lost.   The next favourable eclipse will doubtless find special objects for examination ready, and we should not let the distance alone of the central line make this useless.   There are other difficulties, but they can be got over if taken in time.   In India, besides the Astronomer at Madras, there are the officers of the Indian Trigonometrical Survey, and a few others who would, I believe, be glad to have this opportunity of adding to our knowledge, but they are scattered and could not leave their stations without the permission of the Government, and obtaining this would be facilitated by a representation to the Secretary of State for India.   It will not do to wait.   I believe I may safely say that there is hardly any instrumental means in India suitable for the making of these observations.   All appliances must be procured from England, and soon enough for the intending observers to become used to them before the precious few minutes when they are to do their work.   With every confidence in the zeal of those who cultivate science, I think it is more than can be reasonably expected that they should go to the expense of procuring instruments on the chance of being in a position to use them.   It is a case in which I think the Government may well help ; and I should hope that by appointing those who are to share in the responsible operations and furnishing adequate instruments, &c., they would ensure (as far as possible) the attainment of a satisfactory result.   Without this there would be great risk of failure with men collected from different parts who do not understand each other's ways, and who are furnished with indifferent means.   Still something may be done even by volunteers who know that there will be no difficulties in the way of their using such means as they may acquire.

I would suggest that an effort be made to organize at least two parties, each to be complete.   One to be stationed

near the sea in the neighbourhood of Masulipatam and Gun-
toor in such position as may be found best, and the second
inland on the central line about 60 miles south of Hydrabad.
One or other of these parties would, I think, be certain to
obtain observations, and I think both would succeed if the
places be judiciously chosen. The primary object in each
case should be to examine the protuberances; but to identify
them and connect them if possible with appearances ordinarily
visible on the Sun they should be photographed more than
once during the totality, and the disk of the Sun also for a
week on either side of the day of the eclipse.

I trust I have sufficiently called attention to the subject,
and said enough to show that immediate attention is necessary
if any results are to be obtained, both in preparing the means
and selecting the men, and will leave the matter in the hands
of the Council. If I can be of any further use either here or
in India it will be a pleasure to me.

Total Solar Eclipse August 17, 1868. *Central Line and Limits of Totality in India.   2nd Approximation.*

Greenwich Mean Time.	Northern Limit.		Latitude. N.	Central Line.			Southern Limit.	
	Latitude. N.	Longitude. E.		Longitude. E.	Duration of Totality.		Latitude. N.	Longi E.
h m s	o '	o '	o '	o '	m s		o '	o '
15 55 0	17 36·3	71 57·6	16 33·4	71 54·2	5 4·5		15 33·3	71 51·9
15 57 30	17 37·2	73 28·6	16 34·9	73 25·3	5 11·6		15 33·9	73 21·9
16 0 0	17 36·9	74 56·0	16 34·9	74 52·3	5 18·3		15 33·2	74 47·8
16 2 30	17 35·3	76 19·9	16 33·3	76 15·4	5 23·7		15 31·2	76 9·6
16 5 0	17 32·5	77 40·3	16 30·1	77 34·3	5 29·6		15 27·7	77 27·4
16 7 30	17 28·6	78 56·6	16 26·6	78 50·3	5 35·3		15 23·3	78 42·4
16 10 0	17 23·8	80 11·7	16 20·6	80 2·9	5 40·3		15 17·8	79 54·2
16 12 30	17 17·7	81 23·1	16 14·5	81 13·4	5 45·4		15 11·6	81 3·8
16 15 0	17 10·6	82 31·6	16 7·4	82 21·2	5 49·9		15 4·6	82 10·7

In Latitude 16° 40′ N.   Long. 74° 17′ E. (Kolapoor).

The Eclipse commences at $14^h 46^m 11^s$ G.M.T. $= 19^h 43^m 19^s$ Local Mean Time, and the point of first contact is 77° 40′ W. of the N. point, and 0° 30′ Left of the vertex of the Sun's limb.

The Totality commences at $15^h 56^m 20^s$ G.M.T. $= 20^h 53^m 28^s$ Local Mean Time, and it ends at $16^h 1^m 36^s$ G.M.T. $= 20^h 58^m 44^s$ Local M.T.

The Eclipse ends at $17^h 22^m 4^s$ G.M.T. $= 22^h 19^m 12^s$ Local Mean Time, and the point of last contact is 106° 35′ E. of the N. point, and 174° 38′ to the Right of the vertex of the Sun's limb.

At any place near the above point where the geocentric N. latitude is l and the E. longitude λ, the Greenwich times of the above phases will be found from the following equations: —

First Contact.

$$\begin{cases} \cos \omega_1 = 0{\cdot}05310 - [0{\cdot}25560] \sin l + [9{\cdot}74441] \cos l \cos (98° 25' 56'' - \lambda) \\ T_1 = 17^h 48^m 20^s - [3{\cdot}61453] \sin \omega_1 - [3{\cdot}15475] \sin l - [3{\cdot}88264] \cos l \cos (\lambda - 45° 24' 11'') \end{cases}$$

Middle of Totality.

$$\begin{cases} \cos \omega_0 = -\ 2\cdot5753 - [1.72186] \sin l + [1\cdot26225] \cos l \cos (\lambda - 72^\circ\ 51'\ 58'') \\ T_0 = 17^h\ 42^m\ 27^s - [3\cdot32157] \sin l - [3\cdot93471] \cos l \cos (\lambda - 27^\circ\ 9'\ 0'') \end{cases}$$

and the Semi-duration of Totality $= [2\cdot20037] \sin \omega_0.$

End of Eclipse.

$$\begin{cases} \cos \omega_4 = -0\cdot07077 - [0\cdot24273] \sin l + [9\cdot85757] \cos l \cos (\lambda - 44^\circ\ 57'\ 43'') \\ T_4 = 17^h\ 6^m\ 45^s + [3\cdot71850] \sin \omega_4 - [3\cdot48465] \sin l - [3\cdot97379] \cos l \cos (\lambda - 6^\circ\ 41'\ 16''). \end{cases}$$

In Latitude 16° 31' N. Long. 77° 35' E. (Muktul).

The Eclipse commences at $14^h\ 49^m\ 40^s$ G.M.T. $= 20^h\ 0^m\ 0^s$ of Local Mean Time, and the point of First Contact is 76° 44' W. of the N. point, and 2° 6' Left of the vertex of the Sun's limb.

The Totality commences at $16^h\ 3^m\ 16^s$ G.M.T. $= 21^h\ 12^m\ 36^s$ Local Mean Time, and it ends at $16^h\ 7^m\ 48^s = 21^h\ 18^m\ 8^s.$

The Eclipse ends at $17^h\ 30^m\ 31^s$ G.M.T. $= 22^h\ 40^m\ 51^s$ Local Mean Time, and the point of last contact is 107° 39' to E. of the N. point, or 174° 34' Right of the vertex of the Sun's limb.

Near the above point in Geocentric N. latitude and l and E. longitude λ we shall have :—

First Contact.

$$\begin{cases} \cos \omega_1 = 0\cdot02126 - [0\cdot25476] \sin l + [9\cdot75392] \cos l \cos (95^\circ\ 47'\ 39'' - \lambda) \\ T_1 = 17^h\ 52^m\ 56^s - [3\cdot62868] \sin \omega_1 - [3\cdot19281] \sin l - [3\cdot89569] \cos l \cos (\lambda - 44^\circ\ 17'\ 36'') \end{cases}$$

Middle of Totality.

$$\begin{cases} \cos \omega_0 = -\ 3\cdot0906 - [1\cdot71404] \sin l + [1\cdot27044] \cos l \cos (\lambda - 69^\circ\ 29'\ 45'') \\ T_0 = 17^h\ 42^m\ 50^s - [3\cdot36241] \sin l - [3\cdot94699] \cos l \cos (\lambda - 25^\circ\ 29'\ 27'') \end{cases}$$

and Semi-duration of Totality $= [2\cdot22041] \sin \omega_0.$

End of Eclipse.

$$\begin{cases} \cos \omega_4 = -\ 0\cdot04916 - [0\cdot23945] \sin l + 9\cdot87688 \cos l \cos (\lambda - 40^\circ\ 32'\ 59'') \\ T_4 = 17^h\ 0^m\ 14^s + 3\cdot72851 \sin \omega_4 - [3\cdot52358] \sin l - [3\cdot98066] \cos l \cos (\lambda - 3\ 58'\ 0'') \end{cases}$$

In latitude 16° 10' N. Long. 81° 10' E. (Masulipatam).

The Eclipse commences at $14^h\ 54^m\ 11^s$ G.M.T. $= 20^h\ 18^m\ 51^s$ Local M.T., and the point of first contact is 75° 34' W. of the N. point, and 4° 12' Left of the vertex of the Sun's limb.

The Totality commences at $16^h\ 9^m\ 31^s$ G.M.T. $= 21^h\ 34^m\ 11^s$ Local Mean Time, and ends at $16^h\ 15^m\ 19^s = 21^h\ 39^m\ 59^s.$

The Eclipse ends at $17^h\ 40^m\ 16^s$ G.M.T. $= 23^h\ 4^m\ 56^s$ Local Mean Time, and the point of last contact is 108° 47' E. of the N. point, and 175° 11' Right of the vertex of the Sun's limb.

Near this place in Geocentric N. latitude l, and E. longitude $\lambda.$

First Contact.

$$\begin{cases} \cos \omega_1 = -\ 0\cdot01750 - [0\cdot25371] \sin l + [9\cdot76658] \cos l \cos (92^\circ\ 32'\ 18'' - \lambda) \\ T_1 = 17^h\ 58^m\ 6^s - [3\cdot64464] \sin \omega_1 - [3\cdot23849] \sin l - [3\cdot91095] \cos l \cos (\lambda - 42^\circ\ 54'\ 0'') \end{cases}$$

Middle of Eclipse.

$$\begin{cases} \cos \omega_0 = -\,3\!\cdot\!6099 - [1\!\cdot\!70562]\sin l + [1\!\cdot\!28293]\cos l \cos (\lambda - 65° \, 21' \, 54'') \\ T_0 \; = 17^h \, 42^m \, 6^s - [3\!\cdot\!40989]\sin l - [3\!\cdot\!95954]\cos l \cos (\lambda - 23° \, 24' \, 14'') \end{cases}$$

$$\text{Semi-duration of Totality} = [2\!\cdot\!24130]\sin \omega.$$

Last Contact.

$$\begin{cases} \cos \omega_4 = -\,0\!\cdot\!01944 - [0\!\cdot\!23592]\sin l + [9\!\cdot\!89559]\cos l \cos (\lambda - 36° \, 18' \, 30'') \\ T_4 = 16^h \, 53^m \, 21^s + [3\!\cdot\!73564]\sin \omega_4 - [3\!\cdot\!55759]\sin l - [3\!\cdot\!98439]\cos l \cos (\lambda - 1° \, 14' \, 33''.) \end{cases}$$

Continuation of the Central Line and Limits of Totality across the Bay of Bengal and the Malay Peninsula. 1st Approximation.

Greenwich Mean Time.	Northern Limit. Latitude. N.	Northern Limit. Longitude. E.	Central Line. Latitude. N.	Central Line. Longitude. E.	Southern Limit. Latitude. N.	Southern Limit. Longitude. E.	Remarks.
h m	° ′	° ′	° ′	° ′	° ′	° ′	
16 20	16 56	83 53	15 54	83 47	14 52	83 38	The Second approx-
16 25	16 38	85 57	15 36	85 49	14 33	85 38	imation would not
16 30	16 16	87 55	15 14	87 46	14 12	87 37	shift these lines
16 35	15 51	89 48	14 50	89 38	13 48	89 28	much. The points
16 40	15 25	91 36	14 23	91 25	13 21	91 14	would be moved
16 45	14 56	93 20	13 55	93 8	12 53	92 57	along the lines
16 50	14 25	95 1	13 24	94 48	12 22	94 36	chiefly, so that the
16 55	13 51	96 38	12 51	96 25	11 50	96 12	effect would be a
17 0	13 17	98 14	12 16	98 0	11 15	97 46	change of time.
17 5	12 40	99 47	11 40	99 33	10 39	99 19	
17 10	12 2	101 19	11 1	101 4	10 0	100 49	

On the Spectrum of Mars, with some Remarks on the Colour of that Planet. By WILLIAM HUGGINS, Esq., F.R.S.

On several occasions during the late opposition of *Mars*, I made observations of the spectrum of the solar light reflected from that planet.

The spectroscope which I employed was the same as that of which a description has appeared in my former papers.*
Two instruments were used, one of which is furnished with a

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* " On the Spectra of some of the Fixed Stars." *Phil. Trans.* 1864, p. 415. During my prismatic researches I have tried, and used occasionally, several other arrangements for applying the prism to the telescope. Some of these instruments are fitted with compound prisms, which give direct vision. I have not found any apparatus equal in delicacy and in accuracy to that which is referred to in the text.